

ELEMENTAL COMPOSITION OF APOLLO 15 AND 16 ROCKS,  
FINES AND MINERALS

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Apollo 15 samples

The abundances of 26 elements have been determined by instrumental neutron activation analysis in mineral separates from lunar samples returned by the Apollo 15 mission (Table 1). The abundances of 40 elements in the bulk samples have previously been reported<sup>1)</sup>. The same separation techniques as for the Apollo 14 samples were used<sup>2)</sup>. All fractions were identified by X-ray diffraction. Electron microprobe studies of the minerals are in progress and results will be reported at the conference.

The light and dark pyroxene in 15555 with the Fe/Mg ratios 1.4 (light) and 5.3 (dark) are members of a zoned series.

The REE distribution pattern of each mineral fraction from sample 15555 is compared with the same pattern of the bulk rock (fig. 1). The REE pattern for the other mineral separates are similar.

The Eu anomaly (expressed as the Sm/Eu ratio) in the plagioclase fractions so far analyzed by us (table 3) reflects the observation that the greatest anomaly is found in samples with the highest REE content<sup>3)</sup>.

Apollo 16 samples

The abundances of 35 elements have been determined by neutron activation analysis in five lunar soils returned by the Apollo 16 mission (Table 2).

Due to the late arrival of our samples, the mineral separations and analysis of these fractions are not completed. The results will be presented and discussed in total at the conference.

The five soil samples so far analyzed are: from STA-2 (lunar module site), STA-6 (Stone Mtn.) and STA-13 (Smoky Mtn.).

The fact that they exhibit very similar elemental composition indicates that the regolith of the Descartes area is rather homogeneous. Compared with regoliths from the previous Apollo missions it is enriched in elements such as Na, Al, Ca, and depleted in Mg, Sc, V, Cr, Mn, Fe indicating a higher content of plagioclase. The mean elemental concentrations of the five Apollo 16 fines are compared with the data for sample 15601 from the Hadley-region (fig. 2). In fig. 3 the REE distribution pattern of the fines 63341 is compared with the same pattern of fines from the previous Apollo missions.

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## REFERENCES

- 1) BRUNFELT A.O., HEIER K.S., NILSSEN B., STEINNES E. and SUNDVOLL B. in The Apollo 15 samples (ed. by J.W. Chamberlain and C. Watkins) Lunar Science Institute 1972 page 195-197.
- 2) BRUNFELT A.O., HEIER K.S., NILSSEN B., STEINNES E. and SUNDVOLL B. in Proc. Third Lunar Sci. Conf. Vol. 2, page 1133-1147.
- 3) WAKITA H., REY P. and SCHMITT R.A. in Proc. Second Lunar Sci. Conf. Vol. 2, page 1319-1329.

Table 1. Composition of minerals separated from Apollo 15 samples

	15601,75 regolith			15555,149 basalt				15556,59 basalt		
	plagioclase	clinopyroxene	olivine	plagioclase	clinopyroxene (light)	clinopyroxene (dark)	olivine	plagioclase	clinopyroxene	olivine
Na %	0.75	0.05	0.02	0.72	0.11	0.02	0.09	0.78	0.09	0.01
Mg %	2.3	7.5	16.9	<1.0	7.8	4.1	15.0	<1.0	8.4	8.6
Al %	17.60	1.16	0.87	17.51	2.44	1.22	0.56	17.25	1.62	0.19
Ca %	16.1	0.3	0.9	18.2	6.1	10.3	1.2	13.4	6.7	1.1
Sc ppm	3.3	73.5	25.6	0.5	65.9	71.0	10.0	1.6	79.1	7.4
Ti %	<0.10	0.82	0.23	0.12	0.71	0.76	<0.10	<0.10	0.68	<0.10
V ppm	51	188	220	53	212	115	82	28	209	138
Cr %	0.034	0.290	0.422	0.008	0.531	0.196	0.192	0.012	0.282	0.320
Mn %	0.0195	0.2929	0.2413	0.0075	0.2169	0.3024	0.2842	0.0151	0.2785	0.2639
Fe %	1.5	20.3	19.9	0.5	10.7	21.6	30.5	1.0	21.4	23.9
Co ppm	8.1	45.0	81.0	1.2	32.0	42.2	103.5	4.6	47.7	109.5
Ni ppm	<10	<10	58	<10	148	<10	54	<10	20	<10
Rb ppm	5.5	15.8	<0.9	<0.9	5.1	<0.9	1.3	<0.9	7.0	<0.9
Sr ppm	240	20	60	310	<10	16	<10	19	<10	<10
Ce ppm	<0.10	<0.10	0.40	0.10	0.49	<0.10	1.05	<0.10	<0.10	0.12
Ba ppm	48	<15	39	18	<15	60	25	20	87	<15
La ppm	1.9	2.7	3.4	<0.5	1.0	6.3	1.8	1.0	5.1	<0.5
Sm ppm	1.28	3.37	2.56	0.21	1.84	6.12	0.82	0.58	3.90	0.21
Eu ppm	4.71	<0.40	0.69	1.80	<0.40	0.86	<0.50	4.50	0.66	<0.60
Tb ppm	0.41	0.95	0.35	0.02	0.55	1.20	0.19	0.05	1.15	0.03
Dy ppm	2.0	6.3	2.0	0.1	3.1	6.2	1.1	0.3	5.1	0.25
Yb ppm	0.87	3.7	0.8	0.1	1.6	3.6	0.53	0.2	4.1	0.2
Hf ppm	<0.9	2.4	1.5	<0.9	0.1	3.2	<0.9	<0.9	1.6	0.6
Ta ppm	0.89	0.24	<0.10	<0.10	<0.10	0.13	<0.10	<0.10	<0.10	<0.10
Th ppm	0.37	0.21	0.25	<0.20	<0.20	0.29	<0.20	<0.20	0.53	<0.20
U ppm	0.31	0.10	0.14	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

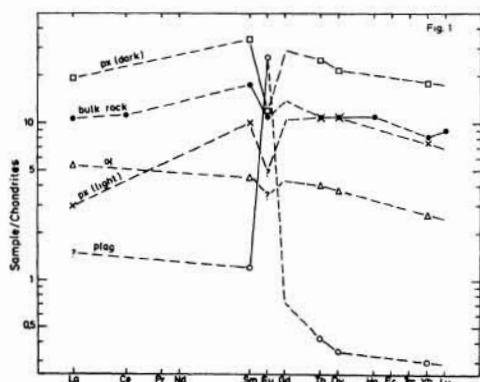


Fig. 1 REE distribution pattern of mineral separates from sample 15555,149

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Table 3. Eu anomaly (expressed as the Sm/Eu ratio) of some bulk samples and their separated mineral fractions.

Sample/description	whole rock	plagioclase	pyroxene
14163 regolith	12.0	0.98	4.7 opx
14310 basalt	9.5	1.57	4.3 opx
15601 regolith	6.3	0.27	8.4 opx
15555 basalt	4.0	0.12	4.6 opx (light)
15556 basalt	4.3	0.13	7.1 opx (dark)
			5.9 opx

Fig. 2 Apollo 12 14 and 16 fines compared with fines 15601, 75

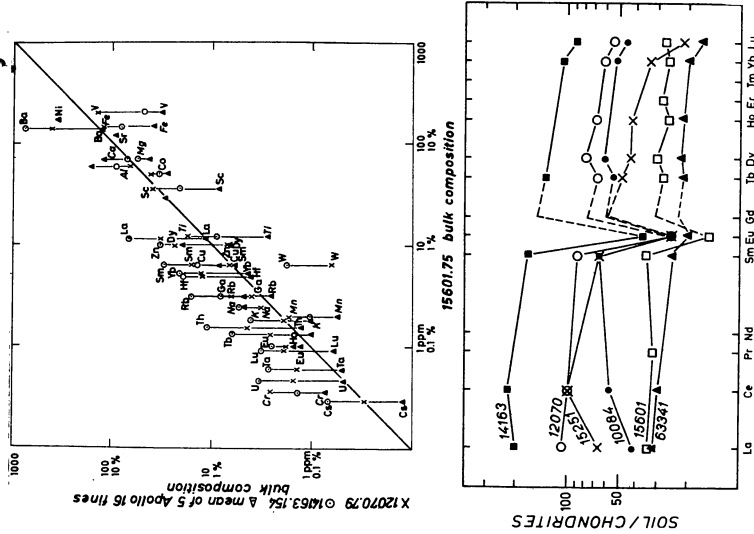


Table 2. Elemental composition of Apollo 16 fines

	62242,2	65321,10	65341,7	63501,28	66031,3
	fines (1-2 mm)	fines (<1 mm)	fines (<1 mm)	lake fines (<1 mm)	fines (<1 mm)
	82A-2	82A-13	82A-13	82A-13	82A-6
Na %	0.41	0.42	0.42	0.42	0.40
Mg %	4.2	4.2	4.4	4.0	4.6
Al %	15.30	15.31	15.35	15.03	14.73
Cl ppm	21	22	20	17	26
K %	0.004	0.064	0.122	0.087	0.060
Ca %	9.4	11.2	8.9	12.0	10.9
S ppm	8.67	8.03	7.95	7.57	9.50
Ti %	0.16	0.21	0.36	0.28	0.36
V ppm	40	46	34	35	26
Cr %	0.0778	0.0642	0.0650	0.0630	0.0798
Mn %	0.0596	0.0528	0.0521	0.0515	0.0597
Fe %	4.04	3.63	3.52	3.59	4.25
Co ppm	41.4	23.5	19.5	22.5	29.4
Ni ppm	397	311	345	322	417
Cu ppm	4.8	9.3	8.3	9.8	8.0
Zn ppm	25	23	17	21	12
Ga ppm	4.3	5.5	5.2	4.2	4.9
Rb ppm	3.4	2.3	1.7	1.5	3.8
Sr ppm	<10	170	140	140	70
In ppm	48	40	45	31	50
Cs ppm	<0.01	0.20	0.05	0.12	0.26
Ba ppm	128	147	92	104	137
La ppm	12.9	10.8	11.2	9.7	12.2
Ce ppm	33.2	24.8	25.2	21.3	38.5
Sm ppm	6.00	4.56	4.45	4.25	6.56
Eu ppm	1.22	1.35	1.42	1.19	1.28
Tb ppm	1.14	0.88	0.93	0.86	1.30
Dy ppm	6.76	4.88	6.18	4.99	7.92
Ho ppm	1.3	1.4	1.5	1.3	1.7
Yb ppm	4.77	3.98	3.87	3.57	5.27
Lu ppm	0.67	0.56	0.56	0.54	0.76
Hf ppm	4.2	4.8	3.5	2.9	5.2
Ta ppm	0.58	0.54	0.45	0.35	0.54
Th ppm	1.5	1.2	1.0	1.0	1.5
U ppm	0.8	0.5	0.4	0.3	0.6

Fig. 3 (right) REE distribution pattern of various lunar fines samples.